

(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

EP 1 227 036 A2

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:  
31.07.2002 Bulletin 2002/31

(51) Int Cl.7: B64C 11/14

(21) Application number: 02250138.1

(22) Date of filing: 09.01.2002

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE TR  
Designated Extension States:  
AL LT LV MK RO SI

(30) Priority: 27.01.2001 GB 0102169

(71) Applicant: ROLLS-ROYCE plc  
London, SW1E 6AT (GB)

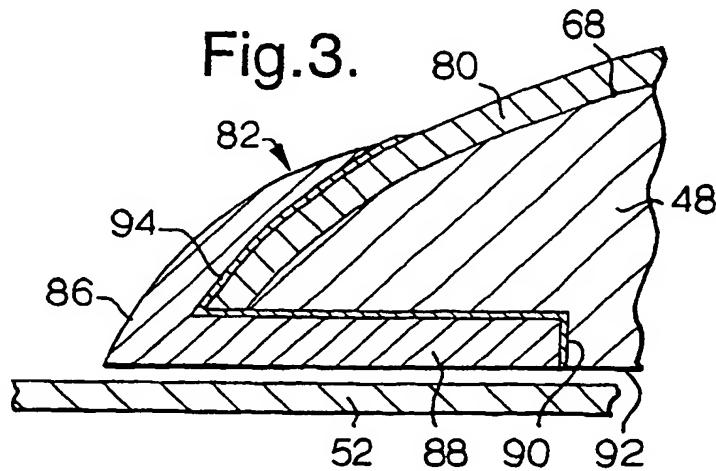
(72) Inventor: Breakwell, Ian Stephen  
Codnor, Derbyshire DE5 9SQ (GB)

(74) Representative: Gunn, Michael Alan  
Rolls-Royce plc  
P.O. Box 31  
Derby DE24 8BJ (GB)

### (54) A gas turbine engine nose cone

(57) A gas turbine engine nose cone (44) comprises a spinner (46) and a fairing (48). The spinner (46) has a conical upstream portion (50) and a cylindrical base portion (52). The fairing (48) is frustoconical and surrounds the base portion (52) of the spinner (46). The outer surface (68) of the fairing (48) forms a continuation

of the outer surface (56) of the conical upstream portion (50) of the spinner (46). The outer surface (68) of the fairing (48) has a skin (80) to protect the fairing (48) from erosion and a protective member (86) extends around the upstream end (82) of the fairing (48) to retain the skin (80) on the upstream end (82) of the fairing (48).



**Description**

[0001] The present invention relates to a gas turbine engine nose cone, particularly a turbofan gas turbine engine nose cone.

[0002] It is known from EP1016588A to provide a gas turbine engine nose cone comprising a spinner having a generally conical upstream portion and a generally cylindrical base portion having a flange removably connected to a fan hub of the gas turbine engine. A frusto-conical fairing surrounds the base portion of the spinner and the outer surface of the fairing forms a continuation of the outer surface of the conical upstream portion of the spinner.

[0003] It is known from GB2011542A to provide a skin on the outer surface of a gas turbine engine nose cone to protect the nose cone from erosion.

[0004] A protective skin has been provided on the outer surface of a fairing of a nose cone comprising a spinner and a fairing, as discussed above. However, the fairing suffers from stripping of the protective skin from the upstream edge of the fairing in operation due to erosion. The protective skin peels off the fairing from the upstream end towards the downstream end in operation of the gas turbine engine due to centrifugal force.

[0005] Accordingly the present invention seeks to provide a novel gas turbine engine nose cone which reduces, preferably overcomes, the above mentioned problems.

[0006] Accordingly the present invention provides a gas turbine engine nose cone comprising a spinner having a generally tapering upstream portion and a generally cylindrical base portion, the cylindrical base portion having a flange removably connected to a fan hub of the gas turbine engine, a tapering fairing surrounding the base portion of the spinner, the outer surface of the fairing forms a continuation of the outer surface of the tapering upstream portion of the spinner, the outer surface of the fairing having a skin to protect the fairing from erosion and a circumferentially extending protective member extending around the upstream end of the fairing to retain the skin on the upstream end of the fairing.

[0007] Preferably the skin comprises polyurethane.

[0008] Preferably the circumferentially extending protective member comprises a silicone elastomer.

[0009] Preferably a radially inner portion of the circumferentially extending protective member locates in an annular groove on the radially inner surface of the upstream end of the fairing.

[0010] Preferably the circumferentially extending protective member is bonded to the upstream end of the fairing.

[0011] Preferably the fairing comprises a fibre-reinforced material. Preferably the spinner comprises a fibre-reinforced material. Preferably the fairing comprises a radially inwardly extending lip to form a seal between the upstream end of the fairing and the spinner.

[0012] The present invention will be more fully de-

scribed by way of example with reference to the accompanying drawings in which:-

5 Figure 1 shows a turbofan gas turbine engine comprising a gas turbine engine nose cone according to the present invention.

Figure 2 is an enlarged cross-sectional view of the gas turbine engine nose cone shown in figure 1.

10 Figure 3 is a further enlarged cross-sectional view of part of the gas turbine engine nose cone shown in figure 2.

Figure 4 is an enlarged cross-sectional view of an alternative embodiment of part of the gas turbine engine nose cone shown in figure 2.

15 [0013] A turbofan gas turbine engine 10, as shown in figure 1, comprises in axial flow series an inlet 12, a fan section 14, a compressor section 16, a combustion section 18, a turbine section 20 and an exhaust nozzle 22.

20 The turbine section 18 comprises a low pressure turbine (not shown) arranged to drive the fan section 14 via a shaft (not shown). The turbine section 18 also comprises a high pressure turbine (not shown) arranged to drive a high pressure compressor (not shown) in the compressor section 14 via a shaft (not shown).

25 The turbine section 18 may also comprise an intermediate pressure turbine (not shown) arranged to drive an intermediate pressure compressor (not shown) in the compressor section 14 via a shaft (not shown). The turbofan gas turbine engine 10 operates quite conventionally and its operation will not be discussed further.

30 [0014] The fan section 14 comprises a fan rotor 24 carrying a plurality of circumferentially spaced radially outwardly extending fan blades 26. The fan rotor 24 and fan blades 26 are surrounded by a fan casing 28 which partially defines a fan duct 30. The fan casing 28 is secured to a core casing 32 by a plurality of circumferentially spaced and radially extending fan outlet guide vanes 34. The fan duct 30 has a fan outlet 36 at its downstream end.

35 [0015] The fan rotor 24 comprises a fan disc 38 and a nose cone 40, as shown more clearly in figure 2. The fan blades 26 and nose cone 40 are mounted on the fan disc 38. The nose cone 40 is generally of a tapering shape with a point at the upstream end 42 and a circular base portion at the downstream end 44. The nose cone 40 may be either conical, dome shaped or any other suitable shape. The nose cone 40 comprises a spinner 46 and a fairing 48.

40 [0016] The spinner 46 comprises a tapering upstream portion 50 and a generally cylindrical base portion 52. The cylindrical base portion 52 comprises a radially outwardly extending flange 54 which is removably connected to the fan disc 38. The tapering upstream portion 50 is preferably conical, but may be dome shaped or other suitable shapes. The tapering upstream portion 50 of the spinner 46 has an outer surface 56. The cylindrical base portion 52 is connected to the fan disc 38 by fas-

teners, for example bolts 58 and nuts 60. The bolts 58 extend axially through apertures 62 in the flange 54 and apertures 66 in a radially outwardly extending flange 64 on the fan disc 38. The spinner 46 preferably comprises a fibre-reinforced material, but may comprise titanium or other suitable lightweight material.

[0017] The fairing 48 tapers and surrounds the base portion 52 of the spinner 46. The outer surface 68 of the fairing 48 forms a continuation of the outer surface 56 of the tapering upstream portion 50 of the spinner 46. The fairing 48 is preferably frustoconical, but other suitable shapes may be used. The fairing 48 is removably connected to the fan disc 38 by a number of circumferentially spaced L-shaped brackets 70. Each L-shaped bracket 70 is secured to the fairing 38 by fasteners, for example bolts 72 and nuts 74. The bolts 72 extend radially through apertures 76 in the fairing 48 and apertures 78 in the L-shaped brackets 70. The bolts 72 have conical heads and the apertures 76 are countersunk. The fairing 48 preferably comprises a fibre-reinforced material, but may comprise titanium or other suitable lightweight material.

[0018] A skin 80 is provided on the outer surface 68 of the fairing 48 to protect the fairing 48 from erosion from particles entering the inlet 12 of the turbofan gas turbine engine 10. Preferably the skin 80 comprises polyurethane, but may comprise other suitable material. The skin 80 extends from the upstream end 82 to the downstream end 84 of the fairing 48.

[0019] A protective member 86 extends around the upstream end 82 of the fairing 48 to retain the skin 80 on the upstream end 82 of the fairing 48, as shown more clearly in figure 3. The protective member 86 extends circumferentially through the full extent of the fairing 48. A radially inner portion 88 of the protective member 86 locates in an annular groove 90 on the radially inner surface 92 at the upstream end 82 of the fairing 48. An adhesive 94 is used to bond the protective member 86 into the annular groove 90 at the upstream end 82 of the fairing 48 and to the skin 80. The protective member 86 preferably comprises a silicone elastomer, but other suitable materials, for example other elastomeric materials, metals, alloys or plastics, may be used. The protective member may comprise a fibre reinforced material for example a fibre reinforced silicone elastomer, eg polyester fibre reinforced silicone elastomer. The protective member 86 extends about 4-5mm along the outer surface 68 of the fairing 48 and over the skin 80. The adhesive 94 comprises silcoset (trade name), or an adhesive 3145 supplied by Dow Corning, but may comprise any other suitable adhesive.

[0020] In operation the protective member 86 prevents the particles that enter the inlet 12 of the turbofan gas turbine engine 10 and impact on the leading edge of the fairing 48 lifting the skin 80 away from the leading edge 82 of the fairing 48. This ensures that the centrifugal force on the fairing 48 and skin 80 does not lead to the subsequent peeling of the skin 80 away from the fair-

ing 48. The fairing 48 is protected from erosion for longer periods of time before a new skin 80 has to be provided on the fairing 80.

[0021] The spinner 46 may also be provided with a skin to protect against erosion from particles entering the inlet 12 of the gas turbine engine 10.

[0022] The embodiment in figure 4 is substantially the same as that in figure 3 but differs in that the protective member 86 has an integral radially inwardly extending lip 94. The lip 94 reduces, preferably prevents, moisture and dirt entering the space between the fairing 48 and the spinner 46 and may also provide vibration damping of the leading edge of the fairing 48. This may allow the deletion of the separate seal shown in figure 2.

15

### Claims

1. A gas turbine engine nose cone (44) comprising a spinner (46) having a generally tapering upstream portion (50) and a generally cylindrical base portion (52), the cylindrical base portion (52) having a flange (54) removably connected to a fan hub (38) of the gas turbine engine, a tapering fairing (48) surrounding the base portion (52) of the spinner (46), the outer surface (68) of the fairing (48) forms a continuation of the outer surface (56) of the tapering upstream portion (50) of the spinner (46), the outer surface (68) of the fairing (48) having a skin (80) to protect the fairing (48) from erosion **characterised in that** a circumferentially extending protective member (86) extends around the upstream end (82) of the fairing (48) to retain the skin (80) on the upstream end (82) of the fairing (48).
2. A gas turbine engine nose cone as claimed in claim 1 wherein the skin (80) comprises polyurethane.
3. A gas turbine engine nose cone as claimed in claim 1 or claim 2 wherein the protective member (86) comprises a silicone elastomer.
4. A gas turbine engine nose cone as claimed in claim 1, claim 2 or claim 3 wherein a radially inner portion (88) of the protective member (86) locates in an annular groove (90) on the radially inner surface (92) of the upstream end (82) of the fairing (48).
5. A gas turbine engine nose cone as claimed in claim 4 wherein the protective member (86) is bonded to the upstream end (82) of the fairing (48).
6. A gas turbine engine nose cone as claimed in any of claims 1 to 5 wherein the fairing (48) comprises a fibre-reinforced material.
7. A gas turbine engine nose cone as claimed in any of claims 1 to 6 wherein the spinner (46) comprises

a fibre-reinforced material.

8. A gas turbine engine nose cone as claimed in any of claims 1 to 7 wherein the protective member (86) comprises a radially inwardly extending lip (94) to form a seal between the upstream end (82) of the fairing (48) and the spinner (46). 5
9. A gas turbine engine nose cone as claimed in any of claims 1 to 8 wherein the protective member (86) comprises reinforcing fibres. 10

15

20

25

30

35

40

45

50

55

Fig.1.

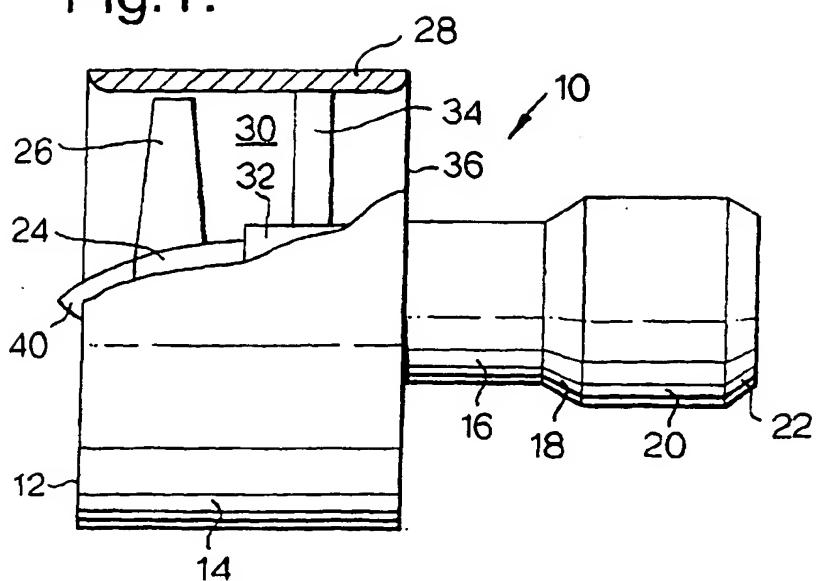


Fig.3.

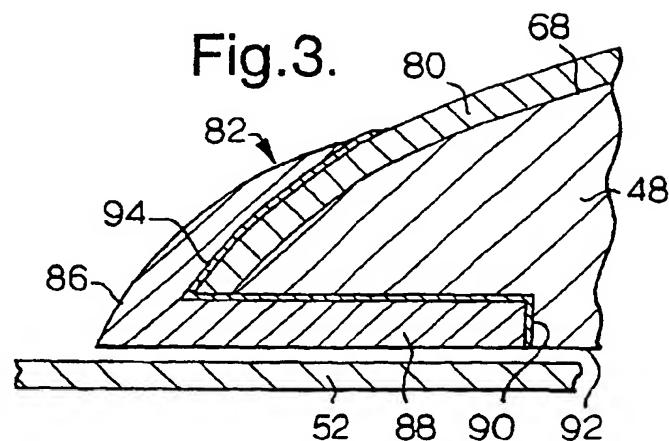


Fig.4.

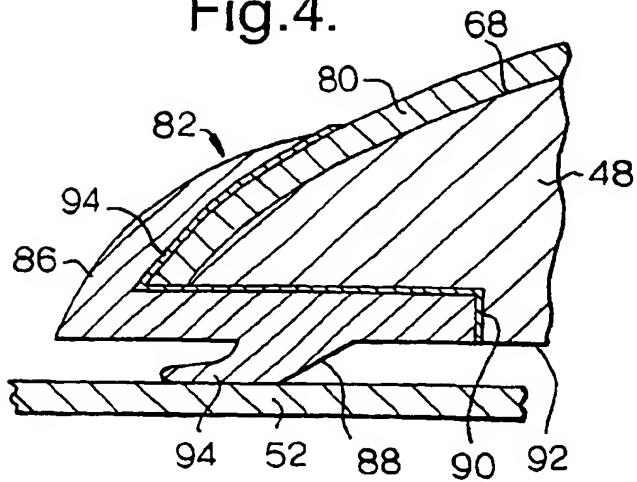
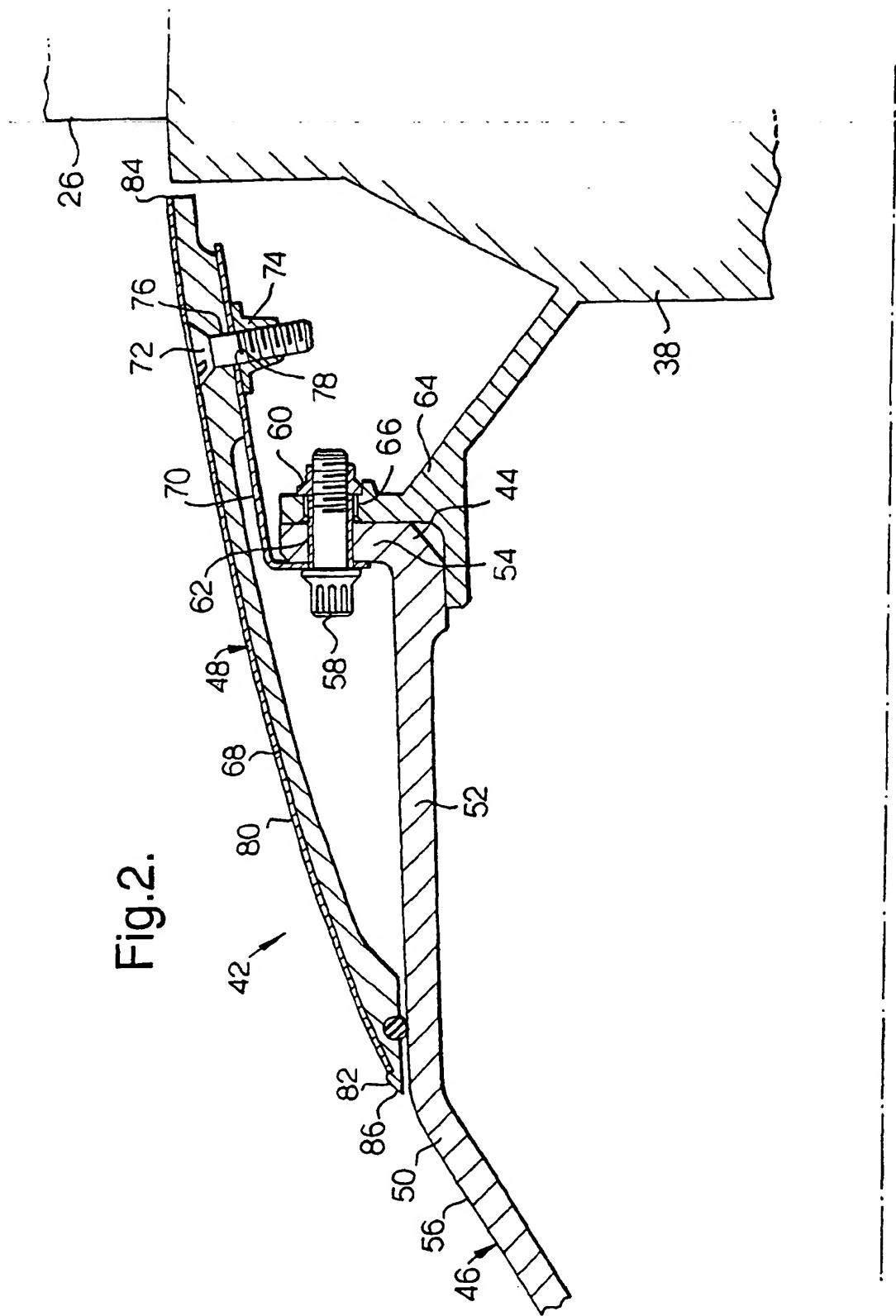


Fig. 2.



(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

EP 1 227 036 A3

(12)

## EUROPEAN PATENT APPLICATION

(88) Date of publication A3:  
22.01.2003 Bulletin 2003/04

(51) Int Cl. 7: B64C 11/14, F02C 7/04

(43) Date of publication A2:  
31.07.2002 Bulletin 2002/31

(21) Application number: 02250138.1

(22) Date of filing: 09.01.2002

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE TR

Designated Extension States:  
AL LT LV MK RO SI

(30) Priority: 27.01.2001 GB 0102169

(71) Applicant: ROLLS-ROYCE plc  
London, SW1E 6AT (GB)

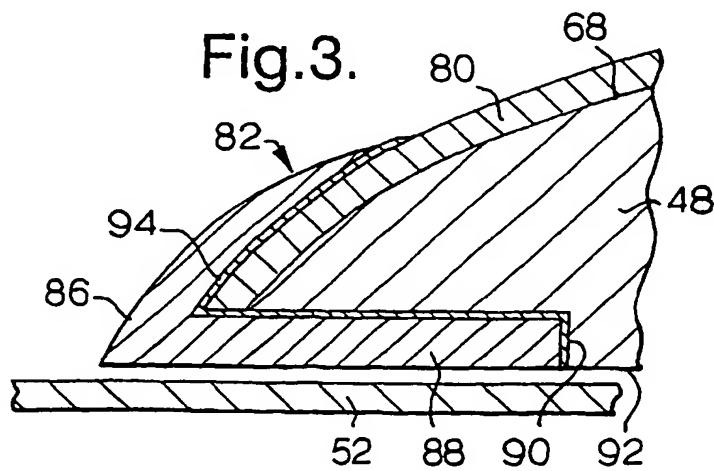
(72) Inventor: Breakwell, Ian Stephen  
Codnor, Derbyshire DE5 9SQ (GB)

(74) Representative: Gunn, Michael Alan  
Rolls-Royce plc  
P.O. Box 31  
Derby DE24 8BJ (GB)

### (54) A gas turbine engine nose cone

(57) A gas turbine engine nose cone (44) comprises a spinner (46) and a fairing (48). The spinner (46) has a conical upstream portion (50) and a cylindrical base portion (52). The fairing (48) is frustoconical and surrounds the base portion (52) of the spinner (46). The outer surface (68) of the fairing (48) forms a continuation

of the outer surface (56) of the conical upstream portion (50) of the spinner (46). The outer surface (68) of the fairing (48) has a skin (80) to protect the fairing (48) from erosion and a protective member (86) extends around the upstream end (82) of the fairing (48) to retain the skin (80) on the upstream end (82) of the fairing (48).





DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
D,A	EP 1 016 588 A (ROLLS ROYCE PLC) 5 July 2000 (2000-07-05) * the whole document * ---	1,6-8	B64C11/14 F02C7/04
D,A	GB 2 011 542 A (ROLLS ROYCE) 11 July 1979 (1979-07-11) * page 1, line 30-32,42-51,89-102,122-125; figures *	2,4,8,9	
A	EP 0 850 831 A (UNITED TECHNOLOGIES CORP) 1 July 1998 (1998-07-01) * column 1, line 3-6,45-47 * * column 1, line 54 - column 2, line 9 * * column 2, line 41-54 * * column 3, line 6-10,23-27 * * column 3, line 55 - column 4, line 33; figures *	1,5-7,9	
A	US 5 252 160 A (SCANLON JOHN F ET AL) 12 October 1993 (1993-10-12) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B64C F02C
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
MUNICH	28 November 2002	Salentiny, G	
CATEGORY OF CITED DOCUMENTS			
X particularly relevant if taken alone		T: theory or principle underlying the invention	
Y particularly relevant if combined with another document of the same category		E: earlier patent document, but published on, or after the filing date	
A technological background		D: document cited in the application	
O: non-written disclosure		L: document cited for other reasons	
P: intermediate document		S: member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 02 25 0138

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

28-11-2002

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 1016588	A	05-07-2000	EP US	1016588 A2 6447255 B1	05-07-2000 10-09-2002
GB 2011542	A	11-07-1979	NONE		
EP 0850831	A	01-07-1998	US EP JP SG	5833435 A 0850831 A2 10196455 A 54611 A1	10-11-1998 01-07-1998 28-07-1998 16-11-1998
US 5252160	A	12-10-1993	US	5149251 A	22-09-1992